Question (1):

(14 Mark)

Choose the most appropriate answer:

[a] New Split Spoon tube is designed .The outside diameter is 50.8mm and its inside diameter is 34.9mm, the type of soil sample is...........

a- Disturbed soil
b- Undisturbed soil
c- Both a and b
d- None of above

[b] If the relative density of soil is 45%, the type of shear failure is...............

a- General shear failure
b- Local shear failure
c- Bunching shear failure
d- Both a and b

[c] When the total weight of soil excavated of foundation equals the total weight of structure to get zero settlement, the foundation is...............

a- Isolated foundation
b- Strap foundation
c- Mat foundation
d- Floating foundation

[d] When the ground water table depth which two times the width of a foundation sitting on the ground surface raises to the natural ground level, the approximate bearing capacity of a foundation constructed on a sandy soil.......................

a- Reduces by 50%
b- Increases by 50%
c- Reduces by 25%
d- Increases by 25%

[e] The consolidation settlement is a maximum in the same soil conditions, if.......................

a- Isolated footing on sand
b- Mat foundation on sand
c- Isolated footing on clay
d- Mat foundation on clay

[f] If the allowable bearing capacity of a footing located at a depth of 2m in clay is 120KN/m^2, its net bearing capacity for □=20 KN/m^3 equal.................

a- 80 KN/m^2
b- 100 KN/m^2
c- 120 KN/m^2
d- 140 KN/m^2

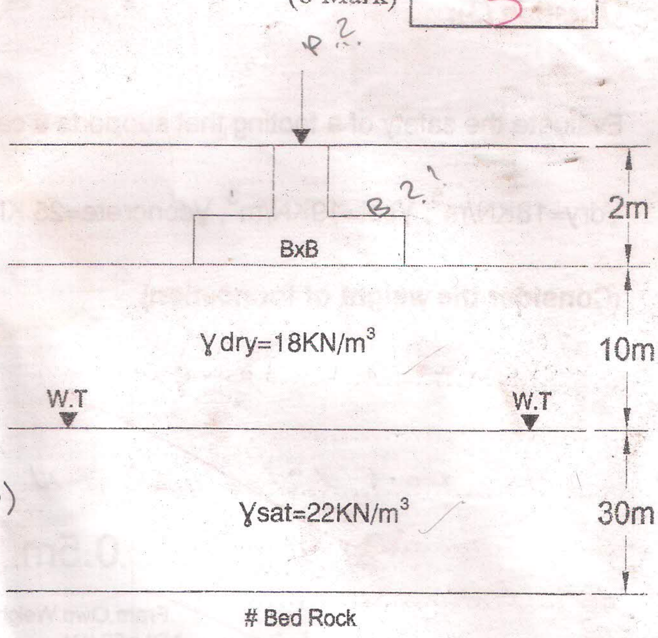
[g] For two soil layers, if the depth of the first layer is relatively large so the q_{ult} of this soil is.....................................

a- q_{ult} = q_{ult} (first layer)
b- q_{ult}= q_{ult} (second layer)
c- q_{ult}= function (soil$_1$, soil$_2$)
d- Both a and c

Question (2): (6 Mark) 5

For the soil profile below, if D_1=10m and D_2=2D_1. = 20 m

a- Determine the dimensions of the foundation to achieve the required depth of bore hall.



D_1 @ $\sigma = \frac{1}{10} q$ equation

D_2 @ $\sigma = 0.05 \sigma_v'$

$\sigma_v' = 10 \times 18 + 30 (22 - 10)$

$= 540 \ kN/m^2$

$0.05 \ \sigma_v' = 540 \times 0.05 = 27 \ kN/m^2$

$27 = \frac{P}{(B + 20)(B + 20)} \Rightarrow 27(B + 20)^2 = P$ eqn (1)

b- Determine the load of column to achieve the required depth of bore hall.

$\frac{1}{10} \times \frac{P}{B^2} = \frac{P}{(B + 10)^2}$

$(B + 10)^2 = 10 B^2$ square root

$B + 10 = \sqrt{10} B$ 3

$B = 4.62 \ m$

substitute in eqn (1)

$27 = \frac{P}{(4.62 + 20)^2} \Rightarrow P = 16365.9 \ kN$ 2

Question (3): (~~15~~ 20 Mark) 15

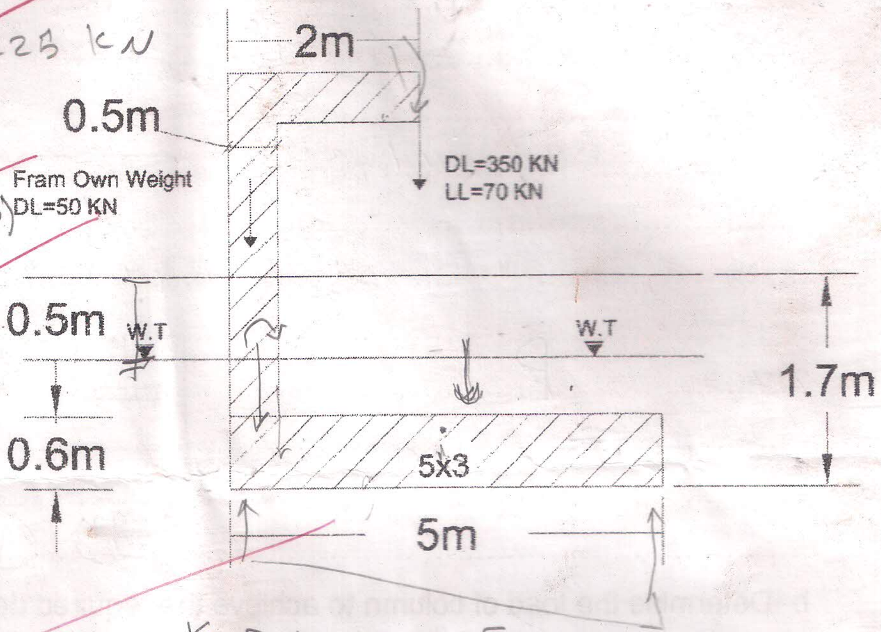
Evaluate the safety of a footing that supports a cantilever as shown below:

γ_{dry}=18KN/m^3, γ_{sat}=19KN/m^3, $\gamma_{concrete}$=25 KN/m^3, Ø=30°, C=0

(Consider the weight of foundation)

weight of foundation

$= 5\times3 \times 0.6 \times 25 = 225$ kN



$q = 0.5 \times 18 + 1.2 (19-10)$

$= 19.8$ kN/m^2

$q_u = c N_c F_{cs} F_{cd} F_{ci}$

$+ q N_q F_{qd} F_{qi} + 0.5 \gamma B N_\gamma F_{\gamma s} F_{\gamma d} F_{\gamma i}$

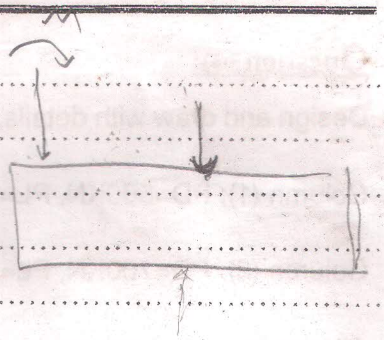
$\frac{D_f}{B} = \frac{1.7}{5} < 1$

$F_{qD} = 1 + 2 \tan 30 (1 - \sin 30)^2 \left(\frac{1.7}{5}\right)$

$= 1.29$

$F_{\gamma d} = 1$

$F_{qi} = F_{\gamma i} = 1$ (No inclination)



$P_{cant} = 350 + 70 + 50 = 470$ kN

$M = 420 \times 2 = 840$ kN.m

~~ΣM @ centroid~~ $= 0$ $\Sigma Q = 0$

$470 + 255 = 15\, q_{all\,net}$

ΣM @ centroid $= 0$

$840 - 470\, e = 0$

$e = 1.78$ m ✗

$B' = B - 2e = 5 - 2 \times 1.78 = 1.44$

$L' = 3$

$F_{qs} = 1 + \frac{1.44}{3} \tan 30 = 1.27$

$F_{\gamma s} = 1 - 0.4 \left(\frac{1.44}{3}\right) = 0.808$

$q_{ult} = 19.8 \times 18.4 \times 1.29 \times 1.27 + 0.5 \times 19 \times 1.44 \times 0.808 \times 1.224 = 837$ kN/m²

$= 485 (1 + 2.136)$

$= 1520$

$FS = \frac{837}{1520} = 0.55$

$q_{ult} = \frac{P}{B \times L} \left(1 + \frac{6e}{B}\right) = \frac{470 + 225}{5 \times 3} \left(1 + \frac{6 \times 1.78}{5}\right)$

أكمل عوة

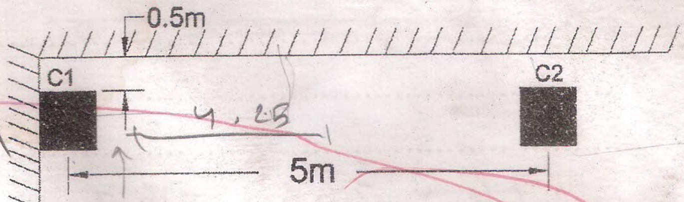
Question (4): (15 Mark) 3

Design and draw with details, the foundation to support the following loads:

Column (1): PD=500KN, PL=250KN and 50x50 cross section.

Column (2): PD=700KN, PL=350KN and 50x50 cross section.

Allowable net soil pressure = 200 KN/m^2.



combined footing

~~rectangular~~ trapisoidal

Q_1 facture = 1.4×500 + 1.7×250 = 1125 KN

Q_2 facture = 1.4×700 + 1.7×350 = 1575 KN

Q_{All} = 1125 + 1575 = 2700 KN

ΣM @ C_1 = 0

1575 × 5 = 2700 x_r

$X_r = \frac{1575 \times 5}{2700} = 2.9$ m

a = 5 − ($\frac{B_2}{2}$ − 0.2) = 4.25 m

ΣM @ C_2 = 0

1125 × 5 = R_1 × 4.25 = 0

R_1 = 1323.5 KN

R_2 = 2700 − 1323.5 = 1376 KN

مع تمنياتنا لكم بالتوفيق و النجاح